

Trends in productivity over the day's work in Southern Italy forestry yard

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Abstract

The purpose of this work was to analyse the changes in labour productivity performance in a forestry yard over the day taking into the account the specialisation of the workers, the organization of the yard and the respect or safety devices during the operation of filling and equipping wood.

The trials were done in a high forest oak. It has been created a circular fixed area plot, including the plants to fell, and were measured the diameter, the height and the volume of each tree of that area.

At the beginning of the working day have been collected information about workers.

The working time of the yard forestry were reported during the stages of felling, limbing and bucking-cut in three different moments of the day.

In terms of the organization of machineries and workers, in the yard there were not a tirfor, a wince and forest tractor.

The results showed an effective organization of the job thanks to a rational alternation of the workers which guaranteed a good level of labour productivity performance. Even if the break of few minutes at the end of each hour didn't decrease enough the level of fatigue connected to the use of a chain saws.

Concerning the trend in productivity of the yard during the work day it was clear that after the lunch the productivity decreased about of 15 %.

Moreover, during the trials we registered a poor use of any personal protective equipment (PPE).

Keywords: working day, accident, safety.

Introduction

The Italian forest is estimated at about 10 million hectares with an annual increase registered in the last decade, equal to 0.3%. Of this high surface more than half is covered by forests managed to coppice, stressing the spread of a species in light of the crisis that has affected the market for firewood during the second half of last century (Jordan, 1981).

In particular, these are the most coppice or coppice with standards and to be considered in crop abandonment in the time between one shift and the subsequent (Ciancio et al., 2004).

The lack of planning also due to the type of property (more than 50% of them are privately owned) and the extension lower average per hectare, leads to an irrational exploitation of the resource wood (Ciancio et al., 2004).

In addition, the operations of forest uses are usually performed only using the chain saws, slaughter processing equipment, and with agricultural machinery extraction equipment, where the morphology of the places allows. These traditional techniques in the past have registered low labour productivity (Febo et al., 1997; Pipitone at al., 2002; Pipitone at al.,

1992). Do not forget also that often working conditions, poor yields by orography land, are of high fatigue of operators with consequent reduction in productivity of the yard. This work was conducted, therefore, in order to analyse processing equipments in the productivity of a yard forest of southern Italy, during a single working day.

Materials and methods

The tests were conducted at a forest ruled a oak coppice privately owned site in Basilicata Short Wood System, as type of foret utilization, which consists of:

- Felling;
- Processing equipment, namely delimiting and cutting on the bed of fall up to 3 cm in diameter, drums landed length of approximately 1 m, typical of firewood;
- Yarding in separate piles, wood and brushwood;
- Extraction equipment the set loader crawler.

Before starting the trials, was conducted a test, whose plants have been subjected to dendrometric measures fundamental to obtain a comprehensive characterization of population under investigation. The following table shows the measurements made and the instruments used.

Table 1. Measurements and instruments used

MEASUREMENTS	MEASURING INSTRUMENTS	CHARACTERISTICS
Delimitation area wise	Measuring roller, Plastic tape	Radius of 20 m
Measure of diameter	Dendrometric caliper	
Measure of the eights	Hypsometer of Blume Leiss	
Relief periods of work	Stopwatch	

For each test field were made the following points:

- ✓ Equipment used;
- ✓ The number and level of specialization of operators in different stages of work;
- ✓ Organization of the yard;
- ✓ Time-working site;
- ✓ Amount of processed wood.

Specifically were found time for use in:

- Felling;
- Limbing;
- Bucking cut.

The methodology of the major periods of work was proposed by Berti et al. (1989) for forestry work, by adopting the method of observation of the various phases of work at regular intervals of two hours in three different time slots corresponding at 9 and 11 in the morning and at 14 in the afternoon. Through this approach, in fact, you can record the stages of work and have an overall percentage of knowing the same period of observation.

Regarding the made of processed wood, were made some measurements on full load.

Finally, during tests, has also registered the degree of use of devices Protective Equipment by operators.

Results

Characterization of forest site

The forest was located in Basilicata. That was a oak coppice with a prevalence of *Quercus cerris* and *Quercus pubescens* and, as the secondary species, *Carpinus betulus* with very dense undergrowth, consisting of hawthorn, ivy, broom and asparagus and that hinders and makes sporadic renovations.

The density of the wood is high with average distance between plants amounted to 2.5 meter and 1600 plants per hectare.

The soil has a discrete inherent fertility but the percentage of skeleton is low. And nature of clay mixed with a discreet presence of silt.

The slope within the forest is not uniform but oscillates between the second and third class.

The internal road network is good and is characterized by the presence of many paths that facilitate the achievement of the forest by the machines.


Equipment used

In the yard forest in question were used the following equipment:

- a) 2 chain saws;
- b) 1 loader crawler;
- c) 1 tractor;
- d) 1 accepts;
- s) 1 billhook.

Here are the technical characteristics of chain saws.

Table 2. Technical characteristics of chainsaw.

Weight without rod	6,5 kg	
Power	4,4/6,0 kW/HP	
Ratio Weight/Power	1,5 kg/kW	
Chain	Oilomatic Rapid Super	
Cut length	40, 45, 50 cm	
Capacity	76,5 cm ³	

Number and specialization of operators

In the yard in question there were 4 operators who were assigned to different tasks and whose degree of specialization is shown in Table 5:

- 1 specialized worker employed by felling;
- 1 worker generic train bucking cut and limbing with chain saws;
- 1 worker generic crew limbing improved by cutting waste stumps with a billhook and burning of brushwood overnight on the spot;
- 1 tractor driver for transporting timber from the bed of a fall to the place of loading trailers.

The culling operations and processing equipment were carried out by a team consisting of three workers: one chain saw operator, one helper and a one general worker. The assistant, during the preparation for the cut, had the task of making free the working area to enable the chain saw operator to make it easier cutting, and thereafter provided to remove from the work

that hindered the brushwood cutting operations, then indicated to chainsaw operator the area of the trunk on which make the cut for wood the same length. The utility man improved the limbing and proceeded to end the working day to burning of slash.

In this work, we have not given the manner and timing of extraction equipment as they were carried out in subsequent days and we concentrated on transactions involving felling and processing equipment of timber.

Table 4. Characterization of the team

Operator	Specialization	Age	Years of experience	Annual period of work (days)
1	Chainsaw operator	47	15	150
2	Utility man	25	5	120
3	Utility man	22	5	120
4	Tractor driver	60	40	150

Organization of the yard

The shipyard provided for the conduct of the following phases:

- 1) felling: including cleaning the area around the tree to be removed through the use of chain saws;
- 2) limbing and bucking cut. This was no separate operations in a net. The first was the disappearance of branches, the second in the trunk cut into pieces measuring default of about 1 meter through the use of chain saws;
- 3) arrangement of material cut in several piles on the bed of fall;
- 4) transfer of timber through a loader crawler or a tractor in an area not far;
- 5) load on the truck trailer;
- 6) further transport by truck.

Time Work

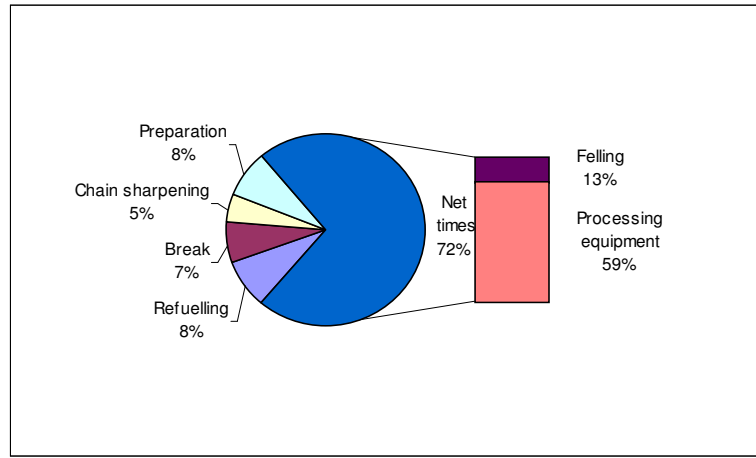
Regarding the timing of work, the yard forestry began his working day at 7:00 to end at 16:00 with a break for lunch from 12:00 to 13:00.

The surveys conducted are served to obtain the following parameters:

- Total time (TT) available for work, calculated by adding the times net (TN) and idle time (TM) transfer and preparation of all work;
- When net work (TN) during which men and means are actively committed to play the different production phases of work;
- Idle time work (TM) during which men and means are present at work but are engaged in preparatory stages of work, the transfer of equipment, maintenance of the same or, in case of accidental breakage of any component, repair and / or replacement of the latter, and not engaged in production phases.

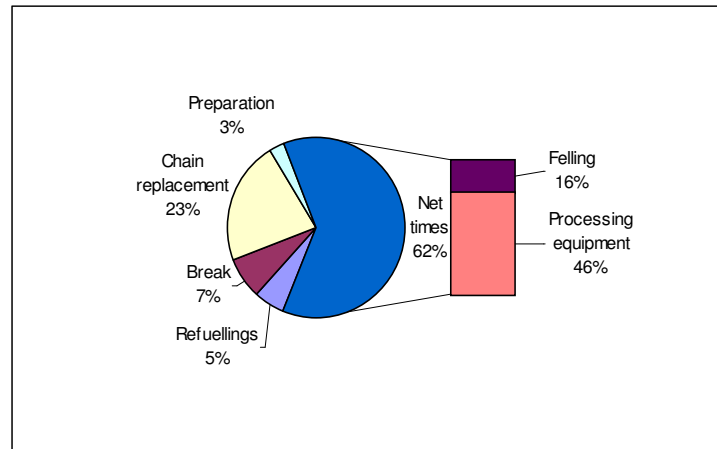
For the purposes of this research were recorded times on the use of plants with a diameter of between 12 and 52 cm.

In the first daypart time net used for the felling and processing equipment had an incidence rate, respectively 23% and 49% of the total. Graph 1, which contains specific times to the felling and their exhibition, shows that the time for the rest accounted for 14% on the total time, sharpening the chain of chain saws for 6% and supply of chain saws for 8%.



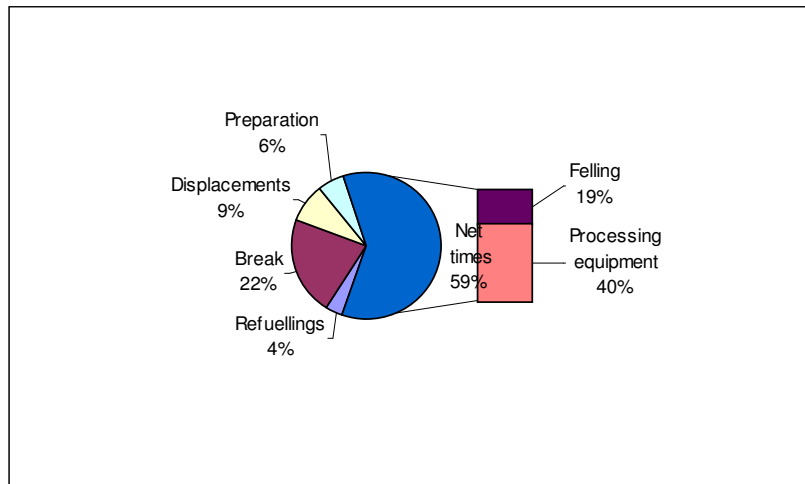
Graph 1. Trend in productivity during the first time band

In the second time band time net used for the felling and processing equipment had an incidence rate, respectively 13% and 59% of the total. Graph 2, which contains specific times to the felling and processing equipment, shows that the time for the rest accounted for 7%, and then to a lesser extent than the first time since the team was able to benefit the stop is necessary for replacing the chain of chain saws, as a result of accidental breakage.

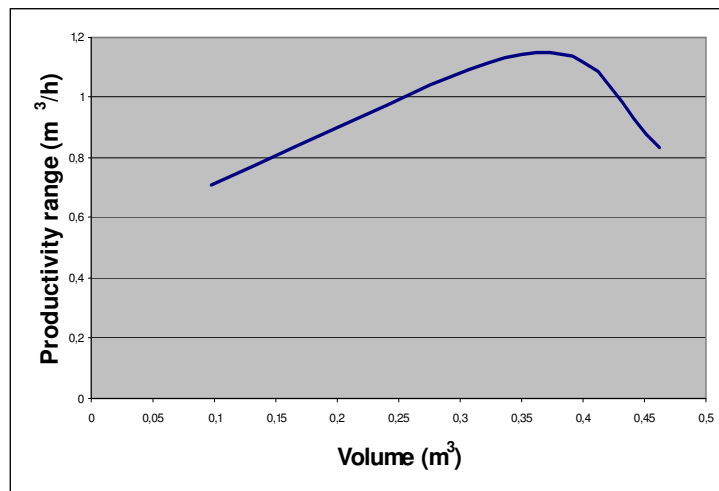


Graph 2. Trend in productivity during the second time band

In its third time band time net used for the felling and processing equipment had an incidence rate, respectively 16% and 46% of the total.



Graph 3. Trend in productivity during the third time band



Graph 4. Trend in productivity during the working day

In the graph 4 we illustrated the trend of productivity range related to the volume of wood felled during the working day.

Conclusions

From the data collected from field trials can draw the following conclusions:

- The characterization of forest site shows that the dense undergrowth and the slope make working conditions inconvenient and cause further fatigue for operators;
- Considering the equipment used, it was clear a no so accurate routine maintenance;
- Concerning the team, this was composed of a sufficient number of workers but with an insufficient degree of specialisation. In this regard, it would be appropriate that the second worker, employee use of chain saws, were specialized to optimize the yard work and to ensure the safe use of this equipment;

- Analysing the time work has shown a substantial increase in rest periods from first to third time band with a consequent reduction in the operational capacity of the yard;
 - Assessment of the yard in terms of machines and men showed the complete lack of tools to help main engine for felling (tirfor, winches and tractors forestry);
 - The average volume shot down over the three slots was equal to 0,307 m³ and productivity average of 0,898 m³/h man with a pek value of 1,15 m³/h per man registered at 11 in the morning. A clear fall in productivity of the yard was recorded during the afternoon time slot closely related to the sense of fatigue by the worker.
- Finally, during the field trials there was a reduced use of personal protective individual and a lack of information on security risks they run operators.

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Each author contributed to that paper in the same measure